AIRS Design File Memorandum #660:

AIRS Level 3 Science Requirements

The call for level 3 products in the science community is universal among those interested in atmospheric dynamics, climate variability and change, and the hydrological cycle. Level 2, on the other hand, is more generally the domain of those interested in instruments and retrieval methodology. The climate change community is broad, and we envision that most level 2 products will be desired but in a level 3 format. Generally, when researchers are asked how they prefer to use AIRS data, the response is, "Gridded."

In order that AIRS data be disseminated and used successfully in the climate research community, we seek to avoid the pitfalls of the MISR experience (complex data format). At the same time, we wish to reach a broad research community both in its diversity of interest and its computational resources. This means level 3 should

- 1. be disseminated in a format that the research community is already accustomed to (HDF, NetCDF, like reanalyses),
- 2. that the data set encompasses many of the level 2 variables (for a broad range of research interests), and
- 3. that the data be of reasonable size (for ease of use by the small user).

It is difficult to achieve all of these conditions simultaneously, so we envision that three types of level 3 products eventually be distributed. We propose calling these "daily", "8-day", and "monthly." See Table 1.

Daily. The community interested in the **daily** level 3 product is the NWP community. NWP is committed to data assimilation, but on occasion it is interested in what a data set is revealing about the weather independent of model and other data. They will be interested in temperature, specific humidity, and geopotential height profiles, cloud thickness, height, and fraction, and surface moisture/emissivity.

8-Day. This community is generally interested in the climate quasi-oscillations and assorted phenomena, such as the Madden-Julian Oscillation, the annular modes, the quasi-biennial oscillation, etc.

Monthly. This community is involved in climate trend analysis. They are generally interested in monthly means over long timescales and prefer data products with the lowest possible systematic errors. For that reason *it is important that all level 2* products be generated using the same versions of calibration and level 2 retrieval.

Daily	8-Day	Monthly
"complex" data, leaves in gores	"moderate" data, no gores	"simple" data, no gores
1°x1° spatial resolution	1°x1° spatial resolution	2°x2° spatial resolution
1-day temporal resolution	8-day temporal resolution	Monthly (calendar)

Table 1. Characteristics of different level 3 data types.

Perfection by learning...

Our approach is to develop the best possible level 3 product through a process of interaction with the research community. We will begin this interaction through the release of a beta version of the data that will contain but a subset of the eventual final level 3 product. After review by the AIRS Science Team and certain other researchers, we look forward to incorporating their comments and criticism into the final level 3 product. The first release will be "Level 3_".

Level 3_: Three consecutive months with a restricted list of variables. This version will contain only the **daily** level 3 product.

For the beta version we will produce...

Product	Level
Temperature	28
Specific humidity	12
Cloud Height	2
Cloud Fraction	2
Column ozone	1
Surface skin temperature	1
Surface air temperature	1
Column liquid water	1
Count	1

The gridding of the level 3_ product is given in Table 2. The memory requirements are based on 2 bytes per scalar anticipating a simple linear compression algorithm for each variable. Three months of data will require 777MB of storage and hence an 850MB capacity compact disc. Quantities relevant to second-moments are put off to the final version of level 3.

Daily	8-Day	Monthly
"complex" data, leaves in gores	"moderate" data, no gores	"simple" data, no gores
1°x1° spatial resolution	1°x1° spatial resolution	2°x2° spatial resolution
1-day temporal resolution	8-day temporal resolution	monthly (calendar)
ascending & descending combined	Ascending & descending	ascending & descending
8 variables ¹ , 49 maps	8 variables, 98 maps	8 variables, 98maps
169MB/month (507/3-months)	84MB/month (252MB/3-months)	6MB/month (18MB/3-months)

Table 2. Requirements for the level 3 beta product.

Envisioned final product: continuous over AIRS lifetime, extended list of variables, day & night separation, microwave & infrared retrieval separation. Temperature and geopotential height are restricted to pressures greater than 1hPa, and specific humidity to pressures greater than 100hPa. Means and standard deviations will be given for each geophysical quantity listed in the tables below. The gridding currently envisioned for the final product is given in Table 3.

For the microwave-only product we will publish the following quantities...

Product	Levels
Temperature	25
Geopotential height	25
Specific humidity	12
Precipitable water	1
Column liquid water	1
Surface pressure ²	1
Surface air temperature	1
Surface skin temperature	1
Microwave surface emissivity ³	1

¹ Two variables profiled at standard levels.

² Include "surface geopotential," a static variable.

³ Not validated

Daily	8-Day	Monthly
"complex" data, leaves in gores	"moderate" data, no gores	"simple" data, no gores
1ºx1º spatial resolution	1ºx1º spatial resolution	2°x2° spatial resolution
1-day temporal resolution	8-day temporal resolution	Monthly (calendar)
ascending & descending	ascending & descending	ascending & descending
microwave-only & infrared	microwave-only & infrared	microwave-only & infrared
17 variables, 447 maps	17 variables, 447 maps	17 variables, 447 maps
1.5GB/month	193MB/month	13MB/month

Table 3. Gridding envisioned for the final level 3 product.

For the *infrared* product we will publish the following quantities...

Product	Levels
Temperature	25
Geopotential height	25
Specific humidity	12
Ozone	28
Precipitable water	1
Column liquid water	1
Column ozone	1
Surface pressure ²	1
Surface air temperature	1
Surface skin temperature	1
VIS cloud fraction (day)	1
Cloud height	2
Cloud fraction	2
OLR	1
Clear OLR	1
Microwave surface emissivity ³	4 or 1
Infrared (spectral?) emissivity ³	7 or 4

Future possibilities

Members of the climate research community are recently showing more and more interest in the climate as a nonlinear system, suggesting that means and standard deviations are not necessarily representative of the climate system. For this reason, the possibility exists that advanced level 3 products contain cluster analyses, a method which is capable of capturing atmospheric variability in a potentially more representative manner. Such an effort would be supported by Dr. Amy Braverman, who is consulting and advising a broad base of the climate research community on this topic.

Stephen Leroy Stephanie Granger February 6, 2004